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### (57) Abstract

**Objects of the Invention**The video demand responsive system which can attain efficient utilization of the communication resource of a two way CATV system is realized.

**Elements of the Invention**If a video demand control device (NU<sub>i</sub>) is formed in a node connection section between a head end (HE) and two or more members' terminal unit and video demand information is transmitted to a head end (HE) from a terminal unit via an upstream, A channel assignment part (8) in a video demand control device (NU<sub>i</sub>), Detect an empty channel zone intact **in a circuit** which can receive a terminal unit and getting down, and a carrier frequency of service sauce sent out from a head end (HE) is extracted further, It puts on this empty channel zone, and was made to transmit to a terminal unit by modulating this service sauce with a carrier frequency of an empty channel zone.

### Claim(s)

**Claim 1**Node connection of between a head end and two or more subscriber terminal equipments is made via a bi-directional CATV transmission line by which frequency division was

carried out and which it gets down and carries out bidirectional transmission by circuit and an upstream, If video demand information which shows a demand of service sauce to the above-mentioned head end from subscriber terminal equipment of the above-mentioned arbitration via said upstream is transmitted, It is a video demand method of said CATV system with which it gets down and the above-mentioned head end sends out the above-mentioned service sauce to the above-mentioned subscriber terminal equipment side via a circuit, Form a video demand control device in said node connection section of said bi-directional CATV transmission line, and with said video demand control device. Detect an empty channel **which can receive said subscriber terminal equipment** zone intact **in a circuit** getting down, and a carrier frequency of said service sauce sent out from said head end is extracted, A video demand method of the feature and a CATV system to carry out putting on this empty channel zone and transmitting to said subscriber terminal equipment by modulating this service sauce with a carrier frequency of said empty channel zone.

**Claim 2**Node connection of between a head end and two or more subscriber terminal equipments is made via a bi-directional CATV transmission line by which frequency division was carried out and which it gets down and carries out bidirectional transmission by circuit and an upstream, If video demand information which shows a demand of service sauce to the above-mentioned head end side from subscriber terminal equipment of the above-mentioned arbitration via said upstream is transmitted, It is a video demand method of said CATV system with which it gets down and the above-mentioned head end sends out the above-mentioned service sauce to the above-mentioned subscriber terminal equipment side via a circuit, Form a video demand control device in said node connection section of said bi-directional CATV transmission line, and with said video demand control device. Receive said video demand information by **said** getting down and performing polling sensing to said arbitrary subscriber terminal equipments using a predetermined frequency band of a circuit and an upstream, and. Said empty channel **getting down** zone intact **in a circuit** which can send out said received video demand information to said head end, and can receive said subscriber terminal equipment if it gets down and polling sensing from said head end is received using a predetermined frequency band of a circuit and an upstream is detected, A carrier frequency of said service sauce sent out from said head end corresponding to said video demand information is extracted, A video demand method of a CATV system putting on this empty channel zone and transmitting to said subscriber terminal equipment by modulating this service sauce with a carrier frequency of said empty channel zone.

**Claim 3**A priority is beforehand set as service sauce demanded by said video demand information, A video demand method of the CATV system according to claim 1 or 2 putting service sauce sent out from said head end on said empty channel zone according to said priority.

**Claim 4**Said head end, polling sensing between said video demand control devices, and polling sensing between said video demand control device and said two or more subscriber terminal equipments, A video demand method of the CATV system according to claim 2 characterized by being serial polling or parallel polling, respectively.

**Claim 5**Said head end, polling sensing between said video demand control devices, and polling sensing between said video demand control device and said two or more subscriber terminal equipments, A video demand method of the CATV system according to claim 2 characterized by being serial polling by TDMA communication, or parallel polling by TDMA communication, respectively.

**Claim 6**In said head end, polling sensing between said video demand control devices, and polling sensing between said video demand control device and said two or more subscriber terminal equipments. A video demand method of the CATV system according to claim 2 transmitting accounting information and viewership information from subscriber terminal equipment on said plurality.

**Claim 7**It is provided in this node connection section of a CATV system which makes node connection of between a head end and two or more subscriber terminal equipments via a bi-directional CATV transmission line by which frequency division was carried out, and which it gets down and carries out bidirectional transmission by circuit and an upstream, If video demand information which shows a demand of service sauce to the above-mentioned head end from subscriber terminal equipment of the above-mentioned arbitration via said upstream is transmitted, Are said above-mentioned service sauce which it gets down and the above-mentioned head end sends out to the above-mentioned subscriber terminal equipment side via a circuit a video demand control device to control, and said video demand control device, Detect

an empty channel **which can receive said subscriber terminal equipment** zone intact **in a circuit** getting down, and a carrier frequency of said service sauce sent out from said head end is extracted, A video demand control device putting on this empty channel zone and transmitting to said subscriber terminal equipment by modulating this service sauce with a carrier frequency of said empty channel zone.

**Claim 8** It is provided in this node connection section of a CATV system which makes node connection of between a head end and two or more subscriber terminal equipments via a bi-directional CATV transmission line by which frequency division was carried out, and which it gets down and carries out bidirectional transmission by circuit and an upstream, If video demand information which shows a demand of service sauce to the above-mentioned head end from subscriber terminal equipment of the above-mentioned arbitration via said upstream is transmitted, Are said above-mentioned service sauce which it gets down and the above-mentioned head end sends out to the above-mentioned subscriber terminal equipment side via a circuit a video demand control device to control, and said video demand control device, Receive said video demand information by **said** getting down and performing polling sensing to said arbitrary subscriber terminal equipments using a predetermined frequency band of a circuit and an upstream, and. If polling sensing from said head end is received using a predetermined frequency band of said going-down circuit and an upstream, Send out said received video demand information to said head end, and detect an empty channel **which can receive said subscriber terminal equipment** zone intact **in a circuit** getting down, and a carrier frequency of said service sauce sent out from said head end corresponding to said video demand information is extracted, A video demand control device putting on this empty channel zone and transmitting to said subscriber terminal equipment by modulating this service sauce with a carrier frequency of said empty channel zone.

**Claim 9** The video demand control device according to claim 7 or 8 putting service sauce which sets a priority as service sauce demanded by said video demand information beforehand, and is sent out from said head end on said empty channel zone according to said priority.

**Claim 10** Said head end and polling sensing between said video demand control devices, The video demand control device according to claim 8 depending polling sensing between said video demand control device and said two or more subscriber terminal equipments on serial polling or parallel polling, respectively.

**Claim 11** Said head end and polling sensing between said video demand control devices, The video demand control device according to claim 8 depending polling sensing between said video demand control device and said two or more subscriber terminal equipments on serial polling by TDMA communication, or parallel polling by TDMA communication, respectively.

**Claim 12** In said head end, polling sensing between said video demand control devices, and polling sensing between said video demand control device and said two or more subscriber terminal equipments. The video demand control device according to claim 8 transmitting accounting information and viewership information from said two or more subscriber terminal equipments.

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## Detailed Description of the Invention

### 0001

**Industrial Application** This invention relates to the video demand control device applied to the video demand method in a two way CATV system, and its video demand method.

### 0002

**Description of the Prior Art** A two way CATV system constitutes a transmission line so that information transmission from a subscriber terminal to a center facility can also be performed, Since the offer of information in the form which responds to a member's request can be performed (this system is hereafter called a video demand responsive system), it has an advantage which can attain the advancement of service. As for this video demand responsive system, a high-speed exchanger, a video server, etc. are installed all over a bidirectional transmission line, Generally the uphill information transmission zone to a center facility from a subscriber terminal 10 MHz - 50 MHz, Frequency division bidirectional transmission of the a large number channel from sensor equipment to a subscriber terminal which gets down, sets an information transmission zone to not less than 70 MHz, and divides the frequency band of each channel into 6 MHz further is carried out simultaneously. And the usual television broadcasting for example, news information, and service sauce, such as a movie, If it gets down for every kind, respectively, and is assigned to the predetermined dedicated channel of the information

transmission zone and the service sauce of a desired kind is required of a center facility from a subscriber terminal, a subscriber terminal can receive via the dedicated channel matched with the kind of the service sauce.

#### **0003**

**Problem(s) to be Solved by the Invention**By the way, if it is in the video demand responsive system of the conventional two way CATV system, Since service sauce is transmitted to a subscriber terminal from a center facility by the dedicated channel by which frequency assignment was carried out beforehand as mentioned above, The further broadband-ization of the whole CATV system is needed in order to attain the advancement of making the kind of service sauce increase etc., and to make a channel number increase. However, since not only broadband-izing of a center facility but broadband-ization about all the devices, such as a trunk amplifier, bridger, etc. which accompany a transmission line and it, is needed for such broadband-ization of the whole CATV system, it is obliged to substantial reconstruction-ization of a system. The very serious problem that it must exchange to the new terminal for broadband CATV systems for the member who owns the subscriber terminal which suited the existing system especially will be invited.

**0004**On the other hand, even if technical and cost SUBJECT is solved on the occasion of this broadband-izing, it has been very important SUBJECT to realize an efficient offer of information within the limited channel number from the necessity of planning efficient use of a communication resource.

**0005**This invention is accomplished in view of such SUBJECT, and is a thing.  
The purpose is to provide the video demand method of the CATV system which can attain efficient utilization, and the video demand control device applied to it.

#### **0006**

It is means in order to solve **SUBJECT. In order to attain such a purpose this invention between a head end and two or more subscriber terminal equipments, Node connection is made via the bi-directional CATV transmission line by which frequency division was carried out and which it gets down and carries out bidirectional transmission by the circuit and an upstream, If the video demand information which shows the demand of service sauce to the above-mentioned head end from the subscriber terminal equipment of the above-mentioned arbitration via said upstream is transmitted, In said CATV system with which it gets down and the above-mentioned head end sends out the above-mentioned service sauce to the above-mentioned subscriber terminal equipment side via a circuit, Form a video demand control device in said node connection section of said bi-directional CATV transmission line, and with the video demand control device. Detect the empty channel which can receive said subscriber terminal equipment zone intact in a circuit getting down, and the carrier frequency of said service sauce sent out from said head end is extracted, It puts on this empty channel zone, and was made to transmit to said subscriber terminal equipment by modulating this service sauce with the carrier frequency of said empty channel zone.**

**0007**The priority is beforehand set as the service sauce demanded by said video demand information, and the service sauce sent out from said head end was put on said empty channel zone according to said priority.

**0008**Receive said video demand information by said getting down and performing polling sensing to said arbitrary subscriber terminal equipments using the predetermined frequency band of a circuit and an upstream, and. When polling sensing from said head end was received using the predetermined frequency band of said going-down circuit and an upstream, said received video demand information was sent out to said head end.

**0009**In these polling sensing, not only video demand information but accounting information, viewership information, etc. from subscriber terminal equipment were transmitted.

**0010**We decided to apply serial polling or a parallel polling scheme to said head end, polling sensing between said video demand control devices, and polling sensing between said video demand control device and said two or more subscriber terminal equipments, respectively.

**0011**Said head end and polling sensing between said video demand control devices, We decided to apply the serial polling by TDMA communication, or the parallel polling

scheme by TDMA communication to polling sensing between said video demand control device and said two or more subscriber terminal equipments, respectively.

**0012**

**Function**Even if according to the video demand method and video demand control device of a CATV system of such composition a head end gets down and it is when the frequency band which can receive subscriber terminal equipment is narrow as compared with the frequency band of a circuit, Since a video demand control device carries out zone assignment and sends out the service sauce sent out from a head end to the empty channel zone in the frequency band which can receive subscriber terminal equipment, continuous use of the existing subscriber terminal equipment can be carried out as it is. Since the video DEMANND information from subscriber terminal equipment is answered and this zone quota processing is performed, the video demand responsive system which is comfortable to a user can be provided. The resources of a CATV communication system can be effectively exploited by using managing the empty channel zone in a free use zone. The effect that the resources of this CATV communication system can be used effectively will demonstrate the effect which was extremely excellent also in future broad-frequency-band-izing.

**0013**

**Example**Hereafter, one example of this invention is described with a drawing. First, if the outline composition of the CATV system in connection with this example is explained based on drawing 1, At the end of the trunk cable (a coaxial cable or a fiber optic cable is comprised) installed from the head end HE in a center facility, a video demand control device. (It is hereafter called node units) Direct continuation of the  $NU_1$  is carried out, or other node-units  $NU_2$  are connected via point and crossing DC. From these node-units  $NU_1$  and  $NU_2$ , two or more branch line cables are installed, and a member's terminal unit  $CM_{11}$ - $CM_{1m}$ ,  $CM_{21}$  -  $CM_{2n}$  are connected to these branch line cables via the tap-off TO provided suitably. Thus, it has composition of the arborescence distribution network centering on the head end HE. The above-mentioned node units are not limited to two node-units  $NU_1$  and  $NU_2$ , for example, are suitably provided for every specific node for carrying out multipoint connection of two or more terminal units in a specific area collectively. Hereafter, these node units shall be named generically by  $NU_i$  ( $i$  is arbitrary natural numbers), and a member's terminal unit shall be named generically by CM.

**0014**The transmission band of this CATV system like the method (see drawing 2) generally held, for example in Japan, The head end HE gets down and frequency band  $W_F$  of a circuit as a range up to 70 MHz thru/or 750 MHz (there is also a case of 550 MHz), The frequency band of each channel is assigned at a time by 6 MHz, and the frequency band of each channel is further assigned at a time for frequency band  $W_R$  of the upstream of the head end HE by 6 MHz as a range up to 10 MHz thru/or 50 MHz.

**0015**On the other hand, frequency band  $W_{BF}$  of the going-down circuit between node-units  $NU_i$  and each terminal unit CM as a range up to 70 MHz thru/or 450 MHz, The frequency band of each channel is assigned at a time by 6 MHz, and the frequency band of each channel is assigned at a time for frequency band  $W_R$  of an upstream by 6 MHz as a range up to 10 MHz thru/or 50 MHz.

**0016**Therefore, between node-units  $UN_i$  and terminal unit CM, a not less than 450-MHz frequency band is not used to bidirectional transmission being performed between the head end HE and each node-units  $UN_i$  using a perimeter wave number zone.

**0017**By terminal unit CM which suited the existing CATV system, it was set as such frequency division because the service sauce of a not less than 450-MHz zone was directly unreceivable. As service sauce which gets down from the head end HE and is incidentally sent out in a circuit (frequency band  $W_{BF}$ ), On zone (70-MHz - 220 MHz)  $W_{TV}$  and in the usual television broadcasting and zone (220-MHz - 450 MHz)  $W_{CM}$ , Various programs, such as news, a sport, a movie, etc. which were made in the studio, are sent out, and this zone  $W_{CM}$  is secured as a variegated use area. And even if use of a not less than 450-MHz frequency band has come to be considered for future

broad-frequency-band-izing and it is existing terminal unit CM, in order to enable use of this not less than 450-MHz frequency band, node-units  $NU_i$  of this invention was developed.

0018Next, the composition of node-units  $NU_i$  is explained with drawing 3. The input buffer amplifier 2 is formed in the connector 1 of the trunk cable installed from the head end HE which gets down and is connected to a circuit, and 1st Utsube Line way  $L_1$  prolonged from the outgoing end of the input buffer amplifier 2 is connected to two or more distribution terminals 4a-4c via the band-pass filter 3.

0019These distribution terminals 4a-4c are the terminal blocks for carrying out direct continuation of terminal unit CM of the downstream, or connecting two or more terminal unit CMs to arborescence via branch line cables and tap-off. The input buffer amplifier 2 and 1st Utsube Line way  $L_1$ , Having transmission band  $W_F$  of the range up to at least 70 MHz thru/or 750 MHz, by having pass band  $W_{BF}$  of the range of 70 MHz thru/or 450 MHz, this zone  $W_{BF}$  gets down and the band-pass filter 3 outputs a line signal to the terminal unit CM side.

0020The upstream signal transmitted via the distribution terminals 4a-4c from arbitrary subscriber-terminals device CMs, The band-pass filter 4 restricted and inputted into zone  $W_R$  in the range of 10 MHz thru/or 50 MHz is formed, and the output of this band-pass filter 4 is connected to the connector 6 via the 2nd Utsube Line way thru/or output buffer amplifier 5. Here, the output buffer amplifier 5 and 2nd Utsube Line way  $L_2$  have transmission band  $W_R$  of the range up to at least 10 MHz thru/or 50 MHz, and the connector 6 is connected to the trunk cable from the head end HE.

0021The control system which has a microprocessor etc. is built in. Namely, the data bus, address bus, and control bus of the central controlling part 7 which comprise CPU. Common connection of the channel assignment part 8, HE polling primary detecting element 9, HC polling sending part 10, the node return signal generating part 11, and the terminal return signal analyzing parts 12 is carried out for (only calling it a bus hereafter), and the following processings are performed under management of the central controlling part 7.

0022First, to two or more terminal unit CMs by which get down and cascade connection is carried out to the distribution terminals 4a-4c using the specific frequency band of a circuit (frequency band  $W_{BF}$ ), HC polling sending part 10 is a given period, and it outputs a polling selecting signal, setting up a terminal address peculiar to each device. In this example, a polling selecting signal is communicated with terminal unit CM up to about 500 pieces at speed of 64K bps or 9600 bps.

0023The terminal return signal analyzing parts 12 receive the terminal return signal returned via an upstream (frequency band  $W_R$ ) from terminal unit CM specified by the polling selecting signal sent out from HC polling sending part 10, Analyze subscriber information included in the terminal return signal, such as accounting information, viewership information, video demand information, the terminal address of each terminal unit CM is made to correspond, and such subscriber information is classified and memorized. It realizes by carrying out every terminal address for every member, i.e., what is called file management, by making each subscriber information into a control item as this memory measure using storages, such as well-known random access memory. Video demand information is what specifies the kind of service sauce which the member operated terminal unit CM and was requested to the head end HE, It is included and transmitted to a terminal return signal using the specific channel zone of the upstream (frequency band  $W_R$ ) of the branch line cables connected to the distribution terminals 4a-4c.

0024HE polling primary detecting element 9 detects the polling selecting signal which gets down from the head end HE and is sent out to each node-units  $NU_i$  using a circuit (frequency band  $W_F$ ), If it detects that it was in agreement with the self address decided beforehand, predetermined answering processing is made to perform to the node return signal generating part 11, and a self address and in being inharmonious, it will disregard the polling selecting signal. Polling selecting to each node-units  $NU_i$

by the head end HE and polling selecting to each subscriber terminal CM by each node-units  $NU_i$  are performed to individual independence.

**0025**If the above-mentioned HE polling primary detecting element 9 detects a self address, the node return signal generating part 11, The subscriber information by which classification management is carried out is read into the terminal return signal analyzing parts 12, and further, such subscriber information is changed into the node return signal of the predetermined channel zone of an upstream (frequency band  $W_R$ ), and it sends out to the head end HE via 2nd Utsube Line way  $L_2$  thru/or the output buffer amplifier 5. Therefore, the subscriber information from each terminal unit CM currently collected by the polling processing by HC polling sending part 10 and the terminal return signal analyzing parts 12, Batch transmission is carried out corresponding to the polling selecting by the head end HE, and the accounting information, the viewership information, and video demand information which are included in this node return signal are provided to the head end HE.

**0026**Generally the head end HE which received such a node return signal, By the video demand information from a certain terminal unit CM, if it analyzes that specific service sauce (for example, movie program etc.) is demanded, it gets down from the demanded service sauce, and sends out using the intact predetermined channel zone of a circuit (frequency band  $W_F$ ).

**0027**The channel assignment part 8 manages the channel of zone  $W_{BF}$  of the going-down circuit to two or more terminal unit CMs. That is, the intact channel (henceforth an empty channel zone) which exists in free use zone  $W_{CM}$  in zone  $W_{BF}$  is investigated one by one, and the terminal return signal analyzing parts 12 determine one of empty channel zones corresponding to the video demand information for every terminal unit CM received and analyzed. And processing which carries out zone conversion and sends out the service sauce transmitted from the head end HE corresponding to video demand information to the empty channel zone to terminal unit CM is performed.

**0028**This zone conversion process is explained in full detail based on drawing 3 - drawing 5. With for example, the program menu signal transmitted from the head end HE using the specific channel zone (specific channel zone in zone  $W_{CM}$ ) shown by carrier frequency  $f_0$  in drawing 3. As shown in drawing 4, suppose that the program menu was displayed on the monitor formed in terminal unit CM, supply of movie sauce was requested from a certain terminal unit  $CM_1$ , and supply of educational program sauce was requested from other terminal unit  $CM_2$ . The terminal return signal analyzing parts 12 in node-units  $NU_i$  analyze the video demand information in each terminal return signal from terminal unit  $CM_1$  and  $CM_2$ , and when the channel assignment part 8 inputs the data of this analysis result, a terminal unit address and the number of video demand are judged. And the channel assignment part 8 from the inside of the empty channel zone investigated one by one, Assignment decision of the empty channel zone (it is hereafter considered as the 1st channel zone and carrier frequency  $f_1$ ) which should transmit movie sauce, and the empty channel zone (it is hereafter considered as the 2nd channel zone and carrier frequency  $f_2$ ) which should transmit educational program sauce is carried out. The carrier frequency (suppose that it is  $f_{H1}$  among drawing 3) of the movie sauce transmitted from the head end HE, The carrier frequency (suppose that it is  $f_{H2}$  among drawing 3) of educational program sauce is detected, to the 1st channel zone by modulating the signal of the movie sauce which reproduced each program sauce inside and was reproduced further by carrier frequency  $f_1$ . change and By modulating the signal of the reproduced educational program sauce by carrier frequency  $f_2$ , it changes into the 2nd channel zone, both gets down, and sends out to a circuit (frequency band  $W_F$ ). Therefore, the channel assignment part 8 in node-units  $NU_i$ , Even if the head end HE transmits service sauce using the zone (not less than 450-MHz zone in drawing 3) which cannot be used by terminal unit CM, frequency assignment processing for the second time is carried out for this service sauce to an available empty channel zone by terminal unit CM. If it is a number of an empty channel zone of within the limits

which are not limited when carrying out frequency assignment to the zone of two channels mentioned above, but exist in frequency band  $W_{CM}$ . Each terminal unit CM is made into ability ready for receiving by performing frequency assignment about two or more service sauce corresponding to video demand information. The channel assignment part 8 builds in beforehand the information on the priority based on the height of viewership, etc. about two or more kinds of service sauce specified by video demand information, and it may be made to control assignment of the service sauce to the above-mentioned empty channel zone according to the priority. Thus, if frequency assignment is performed according to a priority, high utilization of a CATV transmission line can be attained.

0029 If offer of the specific service sauce demanded by video demand information is completed, the channel assignment part 8 will end the frequency assignment to the used channel zone, and will manage it as an empty channel zone for frequency assignment corresponding to other video demand information. When the head end HE transmits service sauce using the arbitrary channel zones in free use zone  $W_{CM}$  which can receive each terminal unit CM, frequency assignment can be carried out to an empty channel zone, and it can transmit to it.

0030 Next, it explains with the flow chart which shows drawing 6 thru/or drawing 8 operation of this example which has this composition. As for drawing 6, the head end HE, drawing 7, and drawing 8 show operation of node units.

0031 First, address  $A_i$  of node-units  $NU_i$  which the head end HE is Step 100 and should be accessed in drawing 6 is set up, A polling selection is performed by frequency band  $W_F$ 's getting down and sending out the node alerting signal which has this address  $A_i$  at Step 110 via a circuit. And in Step 120, if waiting and a node return signal are received for the node return signal from addressed node-units  $NU_i$  being returned, in Step 130, the information on the node return signal will be analyzed. If the demand of the service sauce by the video demand information from one of terminal unit CMs is detected, send out the service sauce here using the proper channel zone in frequency band  $W_F$ , and. The information signal which starts sending out of service sauce is also sent out to node-units  $NU_i$  of a transmission destination. When two or more video demand information exists, simultaneous sending out of the service sauce corresponding to each video demand information is carried out by a respectively individual channel zone. And if another node-units  $NU_i$  is polled by repeating the processing from Step 110 again and new video demand information is detected in Step 130, in Step 140, new service sauce is sent out by a separate channel zone. Thus, the head end HE provides the service sauce corresponding to the video demand of terminal unit CM by polling selecting processing.

0032 Next, operation of node-units  $NU_i$  is explained in drawing 7. Terminal address  $B_k$  of terminal unit  $CM_k$  which HC polling sending part 10 should access in Step 200 is set up, Next, a polling selection is performed by which have this address  $B_k$  at Step 210 carrying out a terminal called, and frequency band  $W_F$ 's getting down and sending out a signal via a circuit. That the terminal return signal which has the accounting information and the viewership information from terminal unit  $CM_k$  which the terminal return signal analyzing parts 12 addressed in Step 220, video demand information, etc. is returned And waiting, In Step 230, reception of this terminal return signal will analyze the information on the terminal return signal. In Step 240, the terminal return signal analyzing parts 12 carry out storage and file management of the accounting information and the viewership information about this terminal unit  $CM_k$ , the video demand information, etc., When there is a request of service sauce by video demand information, The channel assignment part 8 investigates the empty channel zone in free use zone  $W_{CM}$ , and the specific empty channel zone for carrying out zone assignment of the service sauce sent out from the head end HE in Step 140 in above-mentioned drawing 6 in the future is determined. And polling processing is performed to residual terminal unit  $CM_k$  by repeating the processing from Step 200.



**0033**Node-units  $NU_i$  is parallel and performs operation which is shown in drawing 8 in addition to the operation shown in drawing 7. Namely, if HE polling primary detecting element 9 receives the node alerting signal from the head end HE in Step 300, If a node alerting signal is analyzed in Step 310 and the self address is specified, in Step 320, a node return signal will be sent out to the node return signal generating part 11. If the information HE polling primary detecting element 9 indicates the transmission start of service sauce to be in processing of Step 140 of above-mentioned drawing 6 in Step 330 out of a node alerting signal is detected, In Step 340, the channel assignment part 8 determines the specific empty channel zone in free use zone  $W_{CM}$  for zone assignment of service sauce, puts service sauce on the determined zone, and sends out to the terminal unit CM side. Since completion information is transmitted by a node alerting signal also when sending out of the service sauce from the head end HE is completed, If this completion information is detected in the analysis processing of Step 310, in Step 340, the specific channel zone in free use zone  $W_{CM}$  which was being used for transmission of service sauce until now will be again managed as an empty channel zone.

**0034**Thus, even if according to this example the head end HE gets down and frequency band  $W_{BF}$  which can receive subscriber terminal equipment CM is when narrow as compared with frequency band  $W_F$  of a circuit, Since node-units  $NU_i$  carries out zone assignment and sends out the service sauce sent out from the head end HE to the empty channel zone in frequency band  $W_{BF}$  which can receive subscriber terminal equipment CM, continuous use of existing subscriber terminal equipment CM can be carried out as it is. Since the video DEMANNO information from subscriber terminal equipment CM is answered and this zone quota processing is performed, the video demand responsive system which is comfortable to a user can be provided. Since it uses managing the empty channel zone in free use zone  $W_{CM}$ , the resources of a CATV communication system can be exploited effectively. It can be said that the effect that the resources of this CATV communication system can be used effectively demonstrates the effect which was extremely excellent also in future broad-frequency-band-izing.

**0035**Although the case where what is called serial polling was performed by using the same frequency band for the polling selecting which the head end HE performs to each node-units  $UN_i$  to all the node-units  $UN_i$  in this example was described, The peculiar zone is set to each node-units  $UN_i$  of every, and frequency multiplexing transmission may be made to perform what is called parallel polling. Similarly, between each node-units  $NU_i$  and two or more subscriber terminal equipment CMs connected to it, parallel either the same serial polling as the above or polling may be applied suitably.

**0036**Next, other examples are described with drawing 9. Drawing 9 shows the composition of node-units  $NU_i$ , and shows the portion which is the same as that of drawing 3, or corresponds by identical codes. Although the outline composition of the CATV system with which the video demand responsive system of this example is applied is the same as that of drawing 1, The video demand information between each of the head end HE, node-units  $NU_i$ , and subscriber terminal equipment CM is delivered and received with a TDMA (time division multiple access) method. That is, TDMA transmission is performed using the prescribed band of the upstream (frequency band  $W_R$ ) which has connected the upstream (frequency band  $W_R$ ) which has connected node-units  $NU_i$  and two or more subscriber terminal equipment CMs, and node-units  $NU_i$  and the head end HE. And if it puts on the head end HE side from subscriber terminal equipment CM at a TDMA time slot peculiar to the terminal unit CM and video demand information is transmitted, Node-units  $NU_i$  provided in the middle of a transmission route analyzes video demand information, and performs predetermined answering processing, and it acts as intermediary and video demand information is transmitted to the head end HE side.

**0037**In drawing 9, node-units  $NU_i$  of this example, The connector 1 of the trunk cable

installed from the head end HE which gets down and is connected to a circuit (frequency band  $W_F$ ), The input buffer amplifier 2 connected to the connector 1, and 1st Utsube Line way  $L_1$  that connects between the band-pass filters 4 with the outgoing end of the input buffer amplifier 2, Two or more distribution terminals 4a-4c for common connection being carried out to the output of the band-pass filter 3, and connecting two or more subscriber terminal equipment CMs and branch line cables, The band-pass filter 4 which band-limits and inputs the TDMA signal of the upstream (frequency band  $W_R$ ) transmitted via the distribution terminals 4a-4c from arbitrary subscriber-terminals device CMs in 10 MHz thru/or 50 MHz, It has the connector 6 connected to the upstream (frequency band  $W_R$ ) of the head end HE, and the output buffer amplifier 5.

0038The input buffer amplifier 2 and 1st Utsube Line way  $L_1$ , Having transmission band  $W_F$  of the range up to at least 70 MHz thru/or 750 MHz, by having pass band  $W_{BF}$  of the range of 70 MHz thru/or 450 MHz, this zone  $W_{BF}$  gets down and the band-pass filter 3 outputs the signal of a circuit to the subscriber terminal equipment CM side.

0039The control system which has a microprocessor etc. is built in. That is, common connection of the channel assignment part 8, the TDMA frame primary detecting element 13, the demand program information extraction part 14, and the frame multiplexer 15 is carried out to the bus of the central controlling part 7 which comprises CPU, and the following processings are performed under management of the central controlling part 7 into it.

0040First, subscriber information transmitted to the head end HE side from each subscriber terminal equipment CM, such as accounting information, viewership information, video demand information, It puts on the peculiar time slot assigned to each terminal unit CM using the specific band of an upstream (frequency band  $W_R$ ), and is transmitted. That is, when video demand operation for specifying desired service sauce in a certain terminal unit CM is performed, the video demand information which shows the kind of service sauce else, such as accounting information and viewership information, etc. is put on a time slot peculiar to the terminal unit CM, and it is transmitted to it. Suppose that the signal which puts subscriber information on this time slot, and is transmitted to it is hereafter called a TDMA signal.

0041Take a frame synchronization by the TDMA frame primary detecting element's 13 receiving the above-mentioned TDMA signal one by one via the band-pass filter 4, and detecting the unique word in a TDMA signal, and. Video demand information is supplied to the demand program data extraction part 14, and residual subscriber information is supplied to the frame multiplexer 15.

0042The demand program data extraction part 14 restores to video demand information, and extracts the contents of the video demand information for every terminal unit, and supplies them to the channel assignment part 8. The central controlling part 7 supplies the same video demand information to the frame multiplexer 15 simultaneously.

0043Subscriber information, such as accounting information except the video demand information to which the frame multiplexer 15 is supplied from the TDMA frame primary detecting element 13, and viewership information, The TDMA abnormal conditions of the video demand information supplied from the central controlling part 7 are carried out, and it puts and sends out to the time slot to which each node-units  $NU_i$  of every of the prescribed band of the entering circuit by the side of the head end HE was assigned peculiar via the output buffer amplifier 5.

0044Therefore, when the head end HE receives the TDMA signal from node-units  $NU_i$ , It can know in what was made via which node-units  $NU_i$ , and the contents demanded and a demand of service sauce get down corresponding to this, and send out service sauce using the proper channel zone of a circuit (frequency band  $W_F$ ).

0045The channel assignment part 8 manages the channel of zone  $W_{BF}$  of the going-down circuit to two or more subscriber terminal equipment CMs. That is, the intact

channel band (it is called an empty channel zone) which exists in free use zone  $W_{CM}$  in zone  $W_{BF}$  is investigated one by one, and one of empty channel zones is determined corresponding to the video demand information supplied from the demand program information extraction part 14. And processing which carries out zone conversion and sends out the above-mentioned service sauce sent out from the head end HE to the empty channel zone to subscriber terminal equipment CM is performed. Therefore, as mentioned above with drawing 3 - drawing 5, the channel assignment part 8 in this example, Even if the head end HE transmits service sauce using the zone (not less than 450-MHz zone in drawing 3) which cannot be used by subscriber terminal equipment CM, frequency assignment processing for the second time is carried out for this service sauce to an available empty channel zone by subscriber terminal equipment CM. And if offer of the specific service sauce demanded by video demand information is completed, the frequency assignment to the used channel zone will be ended, and it will manage as an empty channel zone for frequency assignment corresponding to other video demand information. When the head end HE transmits service sauce using the arbitrary channel zones in free use zone  $W_{CM}$  which can receive each subscriber terminal equipment CM, frequency assignment is carried out to an empty channel zone, and it transmits to it. The channel assignment part 8 builds in beforehand the information on the priority based on the height of viewership, etc. about two or more kinds of service sauce specified by video demand information, and it may be made to control assignment of the service sauce to the above-mentioned empty channel zone according to the priority. Thus, if frequency assignment is performed according to a priority, high utilization of a CATV transmission line can be attained.

0046As explained above, even if the head end HE gets down and frequency band  $W_{BF}$  which can receive subscriber terminal equipment CM is when narrow as compared with frequency band  $W_F$  of a circuit, this 2nd example, Since node-units  $NU_i$  carries out zone assignment and sends out the service sauce sent out from the head end HE to the empty channel zone in frequency band  $W_{BF}$  which can receive subscriber terminal equipment CM, continuous use of existing subscriber terminal equipment CM can be carried out as it is. Since the video DEMANNO information from subscriber terminal equipment CM is answered and this zone quota processing is performed, the video demand responsive system which is comfortable to a user can be provided. Since it uses managing the empty channel zone in free use zone  $W_{CM}$ , the resources of a CATV communication system can be exploited effectively. It can be said that the effect that the resources of this CATV communication system can be used effectively demonstrates the effect which was extremely excellent also in future broad-frequency-band-izing.

0047On this 2nd example and in between the head end HE and each node-units  $UN_i$ , It may fix only to a specific frequency band and what is called serial TDMA transmission may be performed, the peculiar zone is set up for every node-units  $UN_i$ , and frequency multiplexing transmission may be made to perform what is called parallel TDMA transmission. Parallel TDMA either the same serial TDMA transmission as the above or transmission may be suitably applied between each node-units  $NU_i$  and two or more subscriber terminal equipment CMs connected to it.

0048

Effect of the InventionAs explained above, in this invention, between a head end and two or more subscriber terminal equipments, Node connection is made via the bi-directional CATV transmission line by which frequency division was carried out and which it gets down and carries out bidirectional transmission by the circuit and an upstream, If the video demand information which shows the demand of service sauce to the above-mentioned head end from the subscriber terminal equipment of the above-mentioned arbitration via said upstream is transmitted, In said CATV system with which it gets down and the above-mentioned head end sends out the above-mentioned service sauce to the above-mentioned subscriber terminal equipment side via a circuit, Form a video demand control device in said node connection section of said bi-directional CATV transmission line, and with the video demand control device.

Detect the empty channel which can receive said subscriber terminal equipment zone intact in a circuit getting down, and the carrier frequency of said service sauce sent out from said head end is extracted, It puts on this empty channel zone, and was made to transmit to said subscriber terminal equipment by modulating this service sauce with the carrier frequency of said empty channel zone.

Therefore, for example, even if a head end gets down and it is when the frequency band which can receive subscriber terminal equipment is narrow as compared with the frequency band of a circuit, Since a video demand control device carries out zone assignment and sends out the service sauce sent out from a head end to the empty channel zone in the frequency band which can receive subscriber terminal equipment, continuous use of the existing subscriber terminal equipment can be carried out as it is.

Since the video DEMANNO information from subscriber terminal equipment is answered and this zone quota processing is performed, the video demand responsive system which is comfortable to a user can be provided. The resources of a CATV communication system can be effectively exploited by using managing the empty channel zone in a free use zone. The effect that the resources of this CATV communication system can be used effectively demonstrates the effect which was extremely excellent also in future broad-frequency-band-izing.

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**Industrial Application**This invention relates to the video demand control device applied to the video demand method in a two way CATV system, and its video demand method.

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**Description of the Prior Art**A two way CATV system constitutes a transmission line so that information transmission from a subscriber terminal to a center facility can also be performed, Since the offer of information in the form which responds to a member's request can be performed (this system is hereafter called a video demand responsive system), it has an advantage which can attain the advancement of service. As for this video demand responsive system, a high-speed exchanger, a video server, etc. are installed all over a bidirectional transmission line, Generally the uphill information transmission zone to a center facility from a subscriber terminal 10 MHz - 50 MHz, Frequency division bidirectional transmission of the a large number channel from sensor equipment to a subscriber terminal which gets down, sets an information transmission zone to not less than 70 MHz, and divides the frequency band of each channel into 6 MHz further is carried out simultaneously. And the usual television broadcasting for example, news information, and service sauce, such as a movie, If it gets down for every kind, respectively, and is assigned to the predetermined dedicated channel of the information transmission zone and the service sauce of a desired kind is required of a center facility from a subscriber terminal, a subscriber terminal can receive via the dedicated channel matched with the kind of the service sauce.

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**Effect of the Invention**As explained above, in this invention, between a head end and two or more subscriber terminal equipments, Node connection is made via the bi-directional CATV transmission line by which frequency division was carried out and which it gets down and carries out bidirectional transmission by the circuit and an upstream, If the video demand information which shows the demand of service sauce to the above-mentioned head end from the subscriber terminal equipment of the above-mentioned arbitration via said upstream is transmitted, In said CATV system with which it gets down and the above-mentioned head end sends out the above-mentioned service sauce to the above-mentioned subscriber terminal equipment side via a circuit, Form a video demand control device in said node connection section of said bi-directional CATV transmission line, and with the video demand control device.

Detect the empty channel which can receive said subscriber terminal equipment zone intact in a circuit getting down, and the carrier frequency of said service sauce sent out from said head end is extracted, It puts on this empty channel zone, and was made to transmit to said subscriber terminal equipment by modulating this service sauce with the carrier frequency of said empty channel zone.

Therefore, for example, even if a head end gets down and it is when the frequency band which can receive subscriber terminal equipment is narrow as compared with the frequency band of a circuit, Since a video demand control device carries out zone assignment and sends out the service sauce sent out from a head end to the empty channel zone in the frequency band which can receive subscriber terminal equipment, continuous use of the existing subscriber terminal equipment can be carried out as it is.

Since the video DEMANNO information from subscriber terminal equipment is answered and this zone quota processing is performed, the video demand responsive system which is comfortable to a user can be provided. The resources of a CATV communication system can be effectively exploited by using managing the empty channel zone in a free use zone. The effect that the resources of this CATV communication system can be used effectively demonstrates the effect which was extremely excellent also in future broad-frequency-band-izing.

**Function**Even if according to the video demand method and video demand control device of a CATV system of such composition a head end gets down and it is when the frequency band which can receive subscriber terminal equipment is narrow as compared with the frequency band of a circuit, Since a video demand control device carries out zone assignment and sends out the service sauce sent out from a head end to the empty channel zone in the frequency band which can receive subscriber terminal equipment, continuous use of the existing subscriber terminal equipment can be carried out as it is. Since the video DEMANNO information from subscriber terminal equipment is answered and this zone quota processing is performed, the video demand responsive system which is comfortable to a user can be provided. The resources of a CATV communication system can be effectively exploited by using managing the empty channel zone in a free use zone. The effect that the resources of this CATV communication system can be used effectively will demonstrate the effect which was extremely excellent also in future broad-frequency-band-izing.

**Example**Hereafter, one example of this invention is described with a drawing. First, if the outline composition of the CATV system in connection with this example is explained based on drawing 1, At the end of the trunk cable (a coaxial cable or a fiber optic cable is comprised) installed from the head end HE in a center facility, a video demand control device. (It is hereafter called node units) Direct continuation of the  $NU_1$  is carried out, or other node-units  $NU_2$  are connected via point and crossing DC. From these node-units  $NU_1$  and  $NU_2$ , two or more branch line cables are installed, and a member's terminal unit  $CM_{11}$ - $CM_{1m}$ ,  $CM_{21}$  -  $CM_{2n}$  are connected to these branch line cables via the tap-off TO provided suitably. Thus, it has composition of the arborescence distribution network centering on the head end HE. The above-mentioned node units are not limited to two node-units  $NU_1$  and  $NU_2$ , for example, are suitably provided for every specific node for carrying out multipoint connection of two or more terminal units in a specific area collectively. Hereafter, these node units shall be named generically by  $NU_i$  ( $i$  is arbitrary natural numbers), and a member's terminal unit shall be named generically by CM.

**0014**The transmission band of this CATV system like the method (see drawing 2) generally held, for example in Japan, The head end HE gets down and frequency band  $W_F$  of a circuit as a range up to 70 MHz thru/or 750 MHz (there is also a case of 550 MHz), The frequency band of each channel is assigned at a time by 6 MHz, and the

frequency band of each channel is further assigned at a time for frequency band  $W_R$  of the upstream of the head end HE by 6 MHz as a range up to 10 MHz thru/or 50 MHz. 0015 On the other hand, frequency band  $W_{BF}$  of the going-down circuit between node-units  $NU_i$  and each terminal unit CM as a range up to 70 MHz thru/or 450 MHz, The frequency band of each channel is assigned at a time by 6 MHz, and the frequency band of each channel is assigned at a time for frequency band  $W_R$  of an upstream by 6 MHz as a range up to 10 MHz thru/or 50 MHz.

0016 Therefore, between node-units  $NU_i$  and terminal unit CM, a not less than 450-MHz frequency band is not used to bidirectional transmission being performed between the head end HE and each node-units  $NU_i$  using a perimeter wave number zone.

0017 By terminal unit CM which suited the existing CATV system, it was set as such frequency division because the service sauce of a not less than 450-MHz zone was directly unreceivable. As service sauce which gets down from the head end HE and is incidentally sent out in a circuit (frequency band  $W_{BF}$ ), On zone (70-MHz - 220 MHz)  $W_{TV}$  and in the usual television broadcasting and zone (220-MHz - 450 MHz)  $W_{CM}$ , Various programs, such as news, a sport, a movie, etc. which were made in the studio, are sent out, and this zone  $W_{CM}$  is secured as a variegated use area. And even if use of a not less than 450-MHz frequency band has come to be considered for future broad-frequency-band-izing and it is existing terminal unit CM, in order to enable use of this not less than 450-MHz frequency band, node-units  $NU_i$  of this invention was developed.

0018 Next, the composition of node-units  $NU_i$  is explained with drawing 3. The input buffer amplifier 2 is formed in the connector 1 of the trunk cable installed from the head end HE which gets down and is connected to a circuit, and 1st Utsube Line way  $L_1$  prolonged from the outgoing end of the input buffer amplifier 2 is connected to two or more distribution terminals 4a-4c via the band-pass filter 3.

0019 These distribution terminals 4a-4c are the terminal blocks for carrying out direct continuation of terminal unit CM of the downstream, or connecting two or more terminal unit CMs to arborescence via branch line cables and tap-off. The input buffer amplifier 2 and 1st Utsube Line way  $L_1$ , Having transmission band  $W_F$  of the range up to at least 70 MHz thru/or 750 MHz, by having pass band  $W_{BF}$  of the range of 70 MHz thru/or 450 MHz, this zone  $W_{BF}$  gets down and the band-pass filter 3 outputs a line signal to the terminal unit CM side.

0020 The upstream signal transmitted via the distribution terminals 4a-4c from arbitrary subscriber-terminals device CMs, The band-pass filter 4 restricted and inputted into zone  $W_R$  in the range of 10 MHz thru/or 50 MHz is formed, and the output of this band-pass filter 4 is connected to the connector 6 via the 2nd Utsube Line way thru/or output buffer amplifier 5. Here, the output buffer amplifier 5 and 2nd Utsube Line way  $L_2$  have transmission band  $W_R$  of the range up to at least 10 MHz thru/or 50 MHz, and the connector 6 is connected to the trunk cable from the head end HE.

0021 The control system which has a microprocessor etc. is built in. Namely, the data bus, address bus, and control bus of the central controlling part 7 which comprise CPU. Common connection of the channel assignment part 8, HE polling primary detecting element 9, HC polling sending part 10, the node return signal generating part 11, and the terminal return signal analyzing parts 12 is carried out for (only calling it a bus hereafter), and the following processings are performed under management of the central controlling part 7.

0022 First, to two or more terminal unit CMs by which get down and cascade connection is carried out to the distribution terminals 4a-4c using the specific frequency band of a circuit (frequency band  $W_{BF}$ ), HC polling sending part 10 is a given period, and it outputs a polling selecting signal, setting up a terminal address peculiar to each device. In this example, a polling selecting signal is communicated with terminal unit CM up to about 500 pieces at speed of 64K bps or 9600 bps.

**0023**The terminal return signal analyzing parts 12 receive the terminal return signal returned via an upstream (frequency band  $W_R$ ) from terminal unit CM specified by the polling selecting signal sent out from HC polling sending part 10, Analyze subscriber information included in the terminal return signal, such as accounting information, viewership information, video demand information, the terminal address of each terminal unit CM is made to correspond, and such subscriber information is classified and memorized. It realizes by carrying out every terminal address for every member, i.e., what is called file management, by making each subscriber information into a control item as this memory measure using storages, such as well-known random access memory. Video demand information is what specifies the kind of service sauce which the member operated terminal unit CM and was requested to the head end HE, It is included and transmitted to a terminal return signal using the specific channel zone of the upstream (frequency band  $W_R$ ) of the branch line cables connected to the distribution terminals 4a-4c.

**0024**HE polling primary detecting element 9 detects the polling selecting signal which gets down from the head end HE and is sent out to each node-units  $NU_i$  using a circuit (frequency band  $W_F$ ), If it detects that it was in agreement with the self address decided beforehand, predetermined answering processing is made to perform to the node return signal generating part 11, and a self address and in being inharmonious, it will disregard the polling selecting signal. Polling selecting to each node-units  $NU_i$  by the head end HE and polling selecting to each subscriber terminal CM by each node-units  $NU_i$  are performed to individual independence.

**0025**If the above-mentioned HE polling primary detecting element 9 detects a self address, the node return signal generating part 11, The subscriber information by which classification management is carried out is read into the terminal return signal analyzing parts 12, and further, such subscriber information is changed into the node return signal of the predetermined channel zone of an upstream (frequency band  $W_R$ ), and it sends out to the head end HE via 2nd Utsube Line way  $L_2$  thru/or the output buffer amplifier 5. Therefore, the subscriber information from each terminal unit CM currently collected by the polling processing by HC polling sending part 10 and the terminal return signal analyzing parts 12, Batch transmission is carried out corresponding to the polling selecting by the head end HE, and the accounting information, the viewership information, and video demand information which are included in this node return signal are provided to the head end HE.

**0026**Generally the head end HE which received such a node return signal, By the video demand information from a certain terminal unit CM, if it analyzes that specific service sauce (for example, movie program etc.) is demanded, it gets down from the demanded service sauce, and sends out using the intact predetermined channel zone of a circuit (frequency band  $W_F$ ).

**0027**The channel assignment part 8 manages the channel of zone  $W_{BF}$  of the going-down circuit to two or more terminal unit CMs. That is, the intact channel (henceforth an empty channel zone) which exists in free use zone  $W_{CM}$  in zone  $W_{BF}$  is investigated one by one, and the terminal return signal analyzing parts 12 determine one of empty channel zones corresponding to the video demand information for every terminal unit CM received and analyzed. And processing which carries out zone conversion and sends out the service sauce transmitted from the head end HE corresponding to video demand information to the empty channel zone to terminal unit CM is performed.

**0028**This zone conversion process is explained in full detail based on drawing 3 - drawing 5. With for example, the program menu signal transmitted from the head end HE using the specific channel zone (specific channel zone in zone  $W_{CM}$ ) shown by carrier frequency  $f_0$  in drawing 3. As shown in drawing 4, suppose that the program menu was displayed on the monitor formed in terminal unit CM, supply of movie sauce was requested from a certain terminal unit  $CM_1$ , and supply of educational program sauce was requested from other terminal unit  $CM_2$ . The terminal return signal analyzing parts 12 in node-units  $NU_i$  analyze the video demand information in

each terminal return signal from terminal unit  $CM_1$  and  $CM_2$ , and when the channel assignment part 8 inputs the data of this analysis result, a terminal unit address and the number of video demand are judged. And the channel assignment part 8 from the inside of the empty channel zone investigated one by one, Assignment decision of the empty channel zone (it is hereafter considered as the 1st channel zone and carrier frequency  $f_1$ ) which should transmit movie sauce, and the empty channel zone (it is hereafter considered as the 2nd channel zone and carrier frequency  $f_2$ ) which should transmit educational program sauce is carried out. The carrier frequency (suppose that it is  $f_{H1}$  among drawing 3) of the movie sauce transmitted from the head end HE, The carrier frequency (suppose that it is  $f_{H2}$  among drawing 3) of educational program sauce is detected, to the 1st channel zone by modulating the signal of the movie sauce which reproduced each program sauce inside and was reproduced further by carrier frequency  $f_1$ . change and By modulating the signal of the reproduced educational program sauce by carrier frequency  $f_2$ , it changes into the 2nd channel zone, both gets down, and sends out to a circuit (frequency band  $W_F$ ). Therefore, the channel assignment part 8 in node-units  $NU_i$ , Even if the head end HE transmits service sauce using the zone (not less than 450-MHz zone in drawing 3) which cannot be used by terminal unit CM, frequency assignment processing for the second time is carried out for this service sauce to an available empty channel zone by terminal unit CM. If it is a number of an empty channel zone of within the limits which are not limited when carrying out frequency assignment to the zone of two channels mentioned above, but exist in frequency band  $W_{CM}$ , Each terminal unit CM is made into ability ready for receiving by performing frequency assignment about two or more service sauce corresponding to video demand information. The channel assignment part 8 builds in beforehand the information on the priority based on the height of viewership, etc. about two or more kinds of service sauce specified by video demand information, and it may be made to control assignment of the service sauce to the above-mentioned empty channel zone according to the priority. Thus, if frequency assignment is performed according to a priority, high utilization of a CATV transmission line can be attained.

0029If offer of the specific service sauce demanded by video demand information is completed, the channel assignment part 8 will end the frequency assignment to the used channel zone, and will manage it as an empty channel zone for frequency assignment corresponding to other video demand information. When the head end HE transmits service sauce using the arbitrary channel zones in free use zone  $W_{CM}$  which can receive each terminal unit CM, frequency assignment can be carried out to an empty channel zone, and it can transmit to it.

0030Next, it explains with the flow chart which shows drawing 6 thru/or drawing 8 operation of this example which has this composition. As for drawing 6, the head end HE, drawing 7, and drawing 8 show operation of node units.

0031First, address  $A_i$  of node-units  $NU_i$  which the head end HE is Step 100 and should be accessed in drawing 6 is set up, A polling selection is performed by frequency band  $W_F$ 's getting down and sending out the node alerting signal which has this address  $A_i$  at Step 110 via a circuit. And in Step 120, if waiting and a node return signal are received for the node return signal from addressed node-units  $NU_i$  being returned, in Step 130, the information on the node return signal will be analyzed. If the demand of the service sauce by the video demand information from one of terminal unit CMs is detected, send out the service sauce here using the proper channel zone in frequency band  $W_F$ , and. The information signal which starts sending out of service sauce is also sent out to node-units  $NU_i$  of a transmission destination. When two or more video demand information exists, simultaneous sending out of the service sauce corresponding to each video demand information is carried out by a respectively individual channel zone. And if another node-units  $NU_i$  is polled by repeating the processing from Step 110 again and new video demand information is detected in Step 130, in Step 140, new service sauce is sent out by a separate channel zone. Thus, the head end HE



provides the service sauce corresponding to the video demand of terminal unit CM by polling selecting processing.

0032Next, operation of node-units  $NU_i$  is explained in drawing 7. Terminal address  $B_k$  of terminal unit  $CM_k$  which HC polling sending part 10 should access in Step 200 is set up, Next, a polling selection is performed by which have this address  $B_k$  at Step 210 carrying out a terminal called, and frequency band  $W_F$ 's getting down and sending out a signal via a circuit. That the terminal return signal which has the accounting information and the viewership information from terminal unit  $CM_k$  which the terminal return signal analyzing parts 12 addressed in Step 220, video demand information, etc. is returned And waiting, In Step 230, reception of this terminal return signal will analyze the information on the terminal return signal. In Step 240, the terminal return signal analyzing parts 12 carry out storage and file management of the accounting information and the viewership information about this terminal unit  $CM_k$ , the video demand information, etc., When there is a request of service sauce by video demand information, The channel assignment part 8 investigates the empty channel zone in free use zone  $W_{CM}$ , and the specific empty channel zone for carrying out zone assignment of the service sauce sent out from the head end HE in Step 140 in above-mentioned drawing 6 in the future is determined. And polling processing is performed to residual terminal unit  $CM_k$  by repeating the processing from Step 200.

0033Node-units  $NU_i$  is parallel and performs operation which is shown in drawing 8 in addition to the operation shown in drawing 7. Namely, if HE polling primary detecting element 9 receives the node alerting signal from the head end HE in Step 300, If a node alerting signal is analyzed in Step 310 and the self address is specified, in Step 320, a node return signal will be sent out to the node return signal generating part 11. If the information HE polling primary detecting element 9 indicates the transmission start of service sauce to be in processing of Step 140 of above-mentioned drawing 6 in Step 330 out of a node alerting signal is detected, In Step 340, the channel assignment part 8 determines the specific empty channel zone in free use zone  $W_{CM}$  for zone assignment of service sauce, puts service sauce on the determined zone, and sends out to the terminal unit CM side. Since completion information is transmitted by a node alerting signal also when sending out of the service sauce from the head end HE is completed, If this completion information is detected in the analysis processing of Step 310, in Step 340, the specific channel zone in free use zone  $W_{CM}$  which was being used for transmission of service sauce until now will be again managed as an empty channel zone.

0034Thus, even if according to this example the head end HE gets down and frequency band  $W_{BF}$  which can receive subscriber terminal equipment CM is when narrow as compared with frequency band  $W_F$  of a circuit, Since node-units  $NU_i$  carries out zone assignment and sends out the service sauce sent out from the head end HE to the empty channel zone in frequency band  $W_{BF}$  which can receive subscriber terminal equipment CM, continuous use of existing subscriber terminal equipment CM can be carried out as it is. Since the video DEMANNO information from subscriber terminal equipment CM is answered and this zone quota processing is performed, the video demand responsive system which is comfortable to a user can be provided. Since it uses managing the empty channel zone in free use zone  $W_{CM}$ , the resources of a CATV communication system can be exploited effectively. It can be said that the effect that the resources of this CATV communication system can be used effectively demonstrates the effect which was extremely excellent also in future broad-frequency-band-izing.

0035Although the case where what is called serial polling was performed by using the same frequency band for the polling selecting which the head end HE performs to each node-units  $NU_i$  to all the node-units  $NU_i$  in this example was described, The peculiar zone is set to each node-units  $NU_i$  of every, and frequency multiplexing transmission may be made to perform what is called parallel polling. Similarly, between each node-units  $NU_i$  and two or more subscriber terminal equipment CMs

connected to it, parallel either the same serial polling as the above or polling may be applied suitably.

**0036**Next, other examples are described with drawing 9. Drawing 9 shows the composition of node-units  $NU_i$ , and shows the portion which is the same as that of drawing 3, or corresponds by identical codes. Although the outline composition of the CATV system with which the video demand responsive system of this example is applied is the same as that of drawing 1, The video demand information between each of the head end HE, node-units  $NU_i$ , and subscriber terminal equipment CM is delivered and received with a TDMA (time division multiple access) method. That is, TDMA transmission is performed using the prescribed band of the upstream (frequency band  $W_R$ ) which has connected the upstream (frequency band  $W_R$ ) which has connected node-units  $NU_i$  and two or more subscriber terminal equipment CMs, and node-units  $NU_i$  and the head end HE. And if it puts on the head end HE side from subscriber terminal equipment CM at a TDMA time slot peculiar to the terminal unit CM and video demand information is transmitted, Node-units  $NU_i$  provided in the middle of a transmission route analyzes video demand information, and performs predetermined answering processing, and it acts as intermediary and video demand information is transmitted to the head end HE side.

**0037**In drawing 9, node-units  $NU_i$  of this example, The connector 1 of the trunk cable installed from the head end HE which gets down and is connected to a circuit (frequency band  $W_F$ ), The input buffer amplifier 2 connected to the connector 1, and 1st Utsube Line way  $L_1$  that connects between the band-pass filters 4 with the outgoing end of the input buffer amplifier 2, Two or more distribution terminals 4a-4c for common connection being carried out to the output of the band-pass filter 3, and connecting two or more subscriber terminal equipment CMs and branch line cables, The band-pass filter 4 which band-limits and inputs the TDMA signal of the upstream (frequency band  $W_R$ ) transmitted via the distribution terminals 4a-4c from arbitrary subscriber-terminals device CMs in 10 MHz thru/or 50 MHz, It has the connector 6 connected to the upstream (frequency band  $W_R$ ) of the head end HE, and the output buffer amplifier 5.

**0038**The input buffer amplifier 2 and 1st Utsube Line way  $L_1$ , Having transmission band  $W_F$  of the range up to at least 70 MHz thru/or 750 MHz, by having pass band  $W_{BF}$  of the range of 70 MHz thru/or 450 MHz, this zone  $W_{BF}$  gets down and the band-pass filter 3 outputs the signal of a circuit to the subscriber terminal equipment CM side.

**0039**The control system which has a microprocessor etc. is built in. That is, common connection of the channel assignment part 8, the TDMA frame primary detecting element 13, the demand program information extraction part 14, and the frame multiplexer 15 is carried out to the bus of the central controlling part 7 which comprises CPU, and the following processings are performed under management of the central controlling part 7 into it.

**0040**First, subscriber information transmitted to the head end HE side from each subscriber terminal equipment CM, such as accounting information, viewership information, video demand information, It puts on the peculiar time slot assigned to each terminal unit CM using the specific band of an upstream (frequency band  $W_R$ ), and is transmitted. That is, when video demand operation for specifying desired service sauce in a certain terminal unit CM is performed, the video demand information which shows the kind of service sauce else, such as accounting information and viewership information, etc. is put on a time slot peculiar to the terminal unit CM, and it is transmitted to it. Suppose that the signal which puts subscriber information on this time slot, and is transmitted to it is hereafter called a TDMA signal.

**0041**Take a frame synchronization by the TDMA frame primary detecting element's 13 receiving the above-mentioned TDMA signal one by one via the band-pass filter 4, and detecting the unique word in a TDMA signal, and. Video demand information is supplied to the demand program data extraction part 14, and residual subscriber

information is supplied to the frame multiplexer 15.

**0042**The demand program data extraction part 14 restores to video demand information, and extracts the contents of the video demand information for every terminal unit, and supplies them to the channel assignment part 8. The central controlling part 7 supplies the same video demand information to the frame multiplexer 15 simultaneously.

**0043**Subscriber information, such as accounting information except the video demand information to which the frame multiplexer 15 is supplied from the TDMA frame primary detecting element 13, and viewership information, The TDMA abnormal conditions of the video demand information supplied from the central controlling part 7 are carried out, and it puts and sends out to the time slot to which each node-units  $NU_i$  of every of the prescribed band of the entering circuit by the side of the head end HE was assigned peculiar via the output buffer amplifier 5.

**0044**Therefore, when the head end HE receives the TDMA signal from node-units  $NU_i$ , It can know in what was made via which node-units  $NU_i$ , and the contents demanded and a demand of service sauce get down corresponding to this, and send out service sauce using the proper channel zone of a circuit (frequency band  $W_F$ ).

**0045**The channel assignment part 8 manages the channel of zone  $W_{BF}$  of the going-down circuit to two or more subscriber terminal equipment CMs. That is, the intact channel band (it is called an empty channel zone) which exists in free use zone  $W_{CM}$  in zone  $W_{BF}$  is investigated one by one, and one of empty channel zones is determined corresponding to the video demand information supplied from the demand program information extraction part 14. And processing which carries out zone conversion and sends out the above-mentioned service sauce sent out from the head end HE to the empty channel zone to subscriber terminal equipment CM is performed. Therefore, as mentioned above with drawing 3 - drawing 5, the channel assignment part 8 in this example, Even if the head end HE transmits service sauce using the zone (not less than 450-MHz zone in drawing 3) which cannot be used by subscriber terminal equipment CM, frequency assignment processing for the second time is carried out for this service sauce to an available empty channel zone by subscriber terminal equipment CM. And if offer of the specific service sauce demanded by video demand information is completed, the frequency assignment to the used channel zone will be ended, and it will manage as an empty channel zone for frequency assignment corresponding to other video demand information. When the head end HE transmits service sauce using the arbitrary channel zones in free use zone  $W_{CM}$  which can receive each subscriber terminal equipment CM, frequency assignment is carried out to an empty channel zone, and it transmits to it. The channel assignment part 8 builds in beforehand the information on the priority based on the height of viewership, etc. about two or more kinds of service sauce specified by video demand information, and it may be made to control assignment of the service sauce to the above-mentioned empty channel zone according to the priority. Thus, if frequency assignment is performed according to a priority, high utilization of a CATV transmission line can be attained.

**0046**As explained above, even if the head end HE gets down and frequency band  $W_{BF}$  which can receive subscriber terminal equipment CM is when narrow as compared with frequency band  $W_F$  of a circuit, this 2nd example, Since node-units  $NU_i$  carries out zone assignment and sends out the service sauce sent out from the head end HE to the empty channel zone in frequency band  $W_{BF}$  which can receive subscriber terminal equipment CM, continuous use of existing subscriber terminal equipment CM can be carried out as it is. Since the video DEMANNO information from subscriber terminal equipment CM is answered and this zone quota processing is performed, the video demand responsive system which is comfortable to a user can be provided. Since it uses managing the empty channel zone in free use zone  $W_{CM}$ , the resources of a CATV communication system can be exploited effectively. It can be said that the effect that the resources of this CATV communication system can be used effectively demonstrates the effect which was extremely excellent also in future broad-frequency-band-izing.

**0047**On this 2nd example and in between the head end HE and each node-units  $UN_i$ , It may fix only to a specific frequency band and what is called serial TDMA transmission may be performed, the peculiar zone is set up for every node-units  $UN_i$ , and frequency multiplexing transmission may be made to perform what is called parallel TDMA transmission. Parallel TDMA either the same serial TDMA transmission as the above or transmission may be suitably applied between each node-units  $NU_i$  and two or more subscriber terminal equipment CMs connected to it.

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**Problem(s) to be Solved by the Invention**By the way, if it is in the video demand responsive system of the conventional two way CATV system, Since service sauce is transmitted to a subscriber terminal from a center facility by the dedicated channel by which frequency assignment was carried out beforehand as mentioned above, The further broadband-ization of the whole CATV system is needed in order to attain the advancement of making the kind of service sauce increase etc., and to make a channel number increase. However, since not only broadband-izing of a center facility but broadband-ization about all the devices, such as a trunk amplifier, bridger, etc. which accompany a transmission line and it, is needed for such broadband-ization of the whole CATV system, it is obliged to substantial reconstruction-ization of a system. The very serious problem that it must exchange to the new terminal for broadband CATV systems for the member who owns the subscriber terminal which suited the existing system especially will be invited.

**0004**On the other hand, even if technical and cost SUBJECT is solved on the occasion of this broadband-izing, it has been very important SUBJECT to realize an efficient offer of information within the limited channel number from the necessity of planning efficient use of a communication resource.

**0005**This invention is accomplished in view of such SUBJECT, and is a thing. The purpose is to provide the video demand method of the CATV system which can attain efficient utilization, and the video demand control device applied to it.

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**It is means** in order to solve SUBJECT. In order to attain such a purpose this invention between a head end and two or more subscriber terminal equipments, Node connection is made via the bi-directional CATV transmission line by which frequency division was carried out and which it gets down and carries out bidirectional transmission by the circuit and an upstream, If the video demand information which shows the demand of service sauce to the above-mentioned head end from the subscriber terminal equipment of the above-mentioned arbitration via said upstream is transmitted, In said CATV system with which it gets down and the above-mentioned head end sends out the above-mentioned service sauce to the above-mentioned subscriber terminal equipment side via a circuit, Form a video demand control device in said node connection section of said bi-directional CATV transmission line, and with the video demand control device. Detect the empty channel which can receive said subscriber terminal equipment zone intact in a circuit getting down, and the carrier frequency of said service sauce sent out from said head end is extracted, It puts on this empty channel zone, and was made to transmit to said subscriber terminal equipment by modulating this service sauce with the carrier frequency of said empty channel zone.

**0007**The priority is beforehand set as the service sauce demanded by said video demand information, and the service sauce sent out from said head end was put on said empty channel zone according to said priority.

**0008**Receive said video demand information by said getting down and performing polling sensing to said arbitrary subscriber terminal equipments using the predetermined frequency band of a circuit and an upstream, and. When polling sensing from said head end was received using the predetermined frequency band of said going-down circuit and an upstream, said received video demand information

was sent out to said head end.

**0009**In these polling sensing, not only video demand information but accounting information, viewership information, etc. from subscriber terminal equipment were transmitted.

**0010**We decided to apply serial polling or a parallel polling scheme to said head end, polling sensing between said video demand control devices, and polling sensing between said video demand control device and said two or more subscriber terminal equipments, respectively.

**0011**Said head end and polling sensing between said video demand control devices, We decided to apply the serial polling by TDMA communication, or the parallel polling scheme by TDMA communication to polling sensing between said video demand control device and said two or more subscriber terminal equipments, respectively.

#### **Brief Description of the Drawings**

**Drawing 1**It is an outline lineblock diagram of the CATV system with which this invention is applied.

**Drawing 2**It is an explanatory view showing an example of the frequency division of the CATV system with which this invention is applied.

**Drawing 3**It is a block diagram showing the composition of the node units in the 1st example.

**Drawing 4**It is an explanatory view showing an example of the service menu displayed on the monitor of subscriber terminal equipment.

**Drawing 5**It is an explanatory view for explaining the function of node units.

**Drawing 6**It is a flow chart for explaining operation of the 1st example.

**Drawing 7**It is a flow chart for explaining operation of the 1st example further.

**Drawing 8**It is a flow chart for explaining operation of the 1st example further.

**Drawing 9**It is a block diagram showing the composition of the node units in the 2nd example.

#### **Description of Notations**

**NU<sub>1</sub>, NU<sub>2</sub>** -- Node units, **CM<sub>11</sub>-CM<sub>1m</sub>, CM<sub>21</sub>-CM<sub>2</sub>** -- Subscriber terminal equipment, **3, 4** -- HE polling primary detecting element, -- A band-pass filter, **7** -- A central controlling part, **8** -- A channel assignment part, **9 10** -- A TDMA frame primary detecting element, **14 /** -- A demand program information extraction part, **15 /** -- Frame multiplexer. -- HC polling sending part, **11** -- A node return signal generating part, **12** -- Terminal return signal analyzing parts, **13**

#### **Drawing 2**

For drawings please refer to the original document.

#### **Drawing 4**

For drawings please refer to the original document.

#### **Drawing 1**

For drawings please refer to the original document.

#### **Drawing 3**

For drawings please refer to the original document.

#### **Drawing 5**

For drawings please refer to the original document.

### **Drawing 6**

For drawings please refer to the original document.

### **Drawing 7**

For drawings please refer to the original document.

### **Drawing 8**

For drawings please refer to the original document.

### **Drawing 9**

For drawings please refer to the original document.

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For drawings please refer to the original document.

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